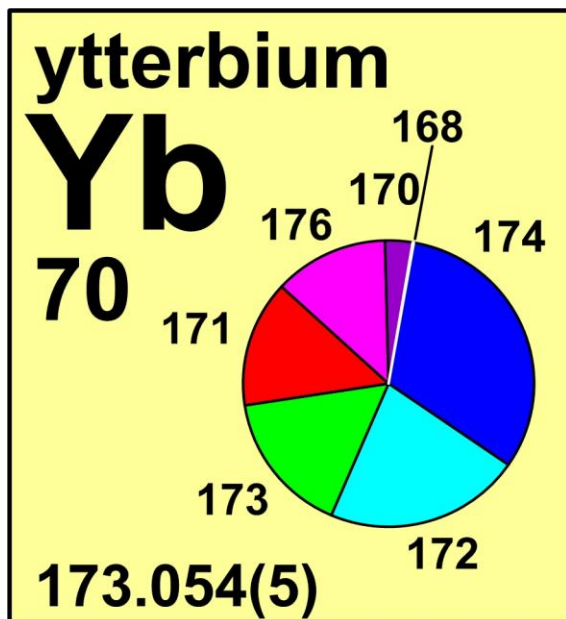


ytterbium

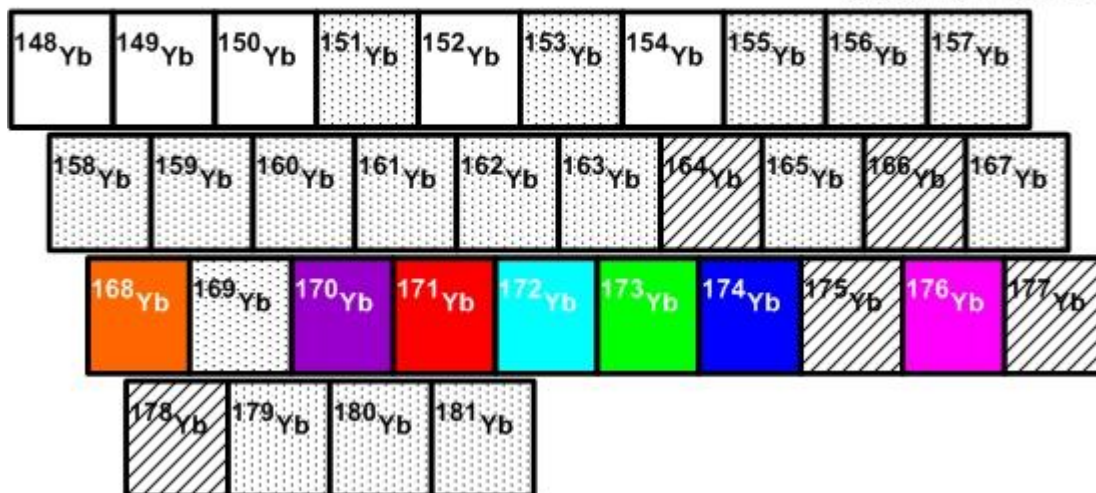


Stable isotope	Atomic mass*	Mole fraction
^{168}Yb	167.933 897	0.0013
^{170}Yb	169.934 7618	0.0304
^{171}Yb	170.936 3258	0.1428
^{172}Yb	171.936 3815	0.2183
^{173}Yb	172.938 2108	0.1613
^{174}Yb	173.938 8621	0.3183
^{176}Yb	175.942 5717	0.1276

* Atomic mass given in unified atomic mass units, u.

Half-life of radioactive isotope

Less than 1 second
Between 1 second and 1 hour
Greater than 1 hour



Important applications of stable and/or radioactive isotopes

Isotopes in industry

- ^{169}Yb emits gamma rays and can be used to create a radiographic image of an object without the use of electricity. A capsule containing ^{169}Yb is placed on one side of the object being screened and photographic film is placed on the other, this will show any flaws in metal casting or welded joints.

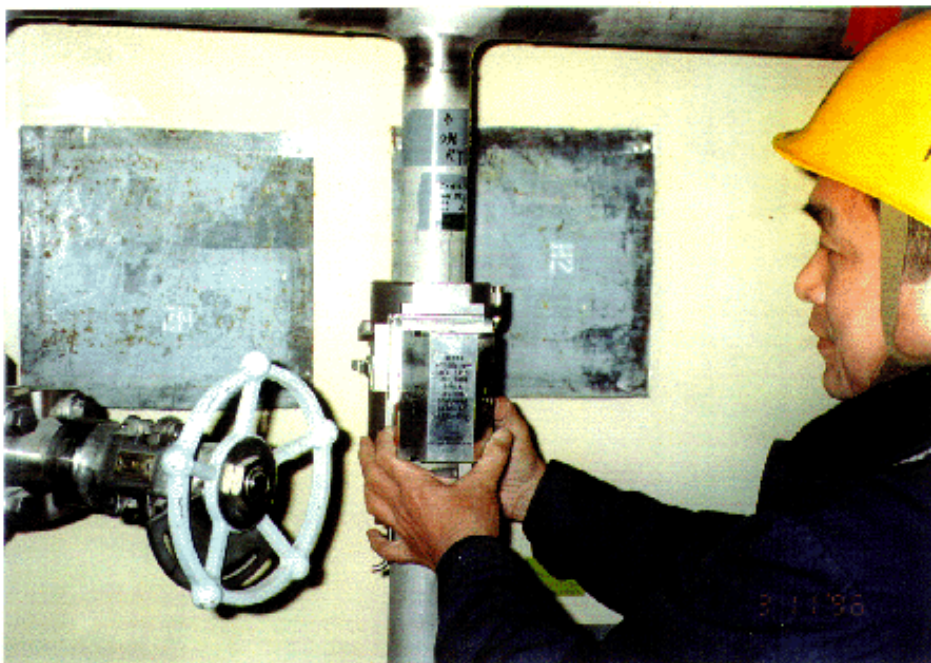


Figure 1: Radiography inspection using ^{169}Yb .

- 2) Gamma cameras use ^{169}Yb as a radiation source. Gamma cameras are used to locate sealed radioactive sources and hot spots in historical waste. Images of the gamma ray intensity are made and then the 2D distribution is superposed on a picture or video images.

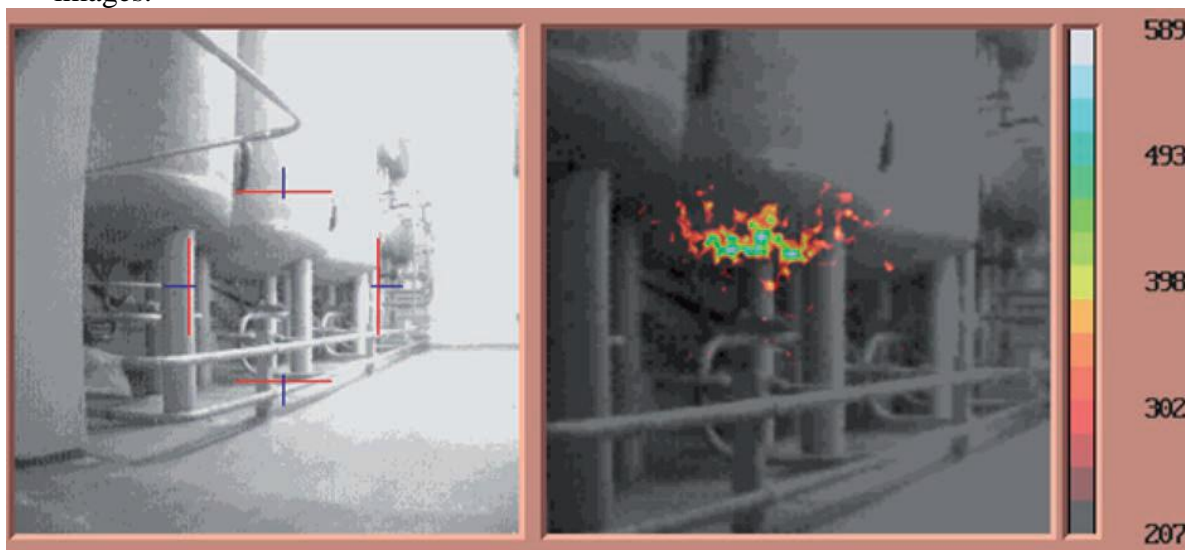


Figure 2: Gamma cameras are typically used to identify radioactive holdup. The picture to the left is of a tank and the picture to the right shows the radioactivity in the tank. (Holdup is material that does not come out of a process as product or waste.)

Isotopes in medicine

- 1) $^{169}\text{Ytterbium}$ is used for cerebrospinal fluid (CSF) studies in the brain. It can be introduced into the CSF through the lumbar or suboccipital puncture. Once in the CSF a

series of scans or scintiphotography can be done to determine the distribution of ^{169}Yb . This helps to determine swelling locations and CSF leaks in the brain that may be caused from a trauma.

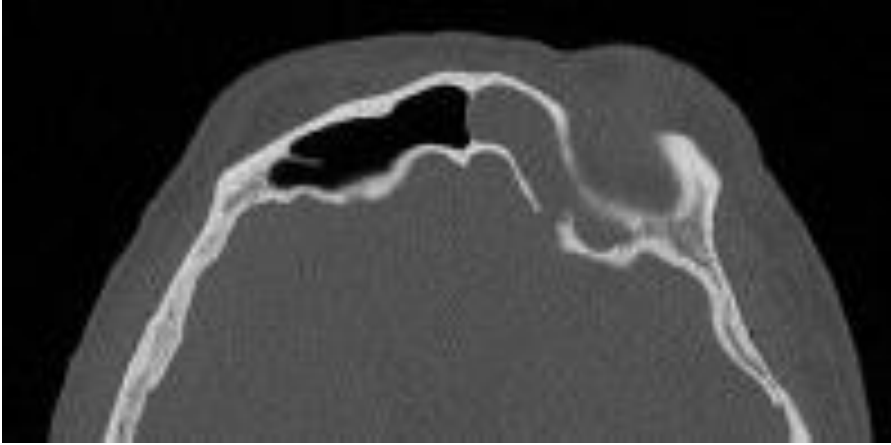


Figure 3: Axial CT of a patient with CSF leak.

- 2) Radioisotope ^{169}Yb is manufactured using ^{168}Yb .
- 3) In the treatment of prostate cancer with brachytherapy seed implants, ^{169}Yb has been suggested as an alternative to using ^{125}I and ^{103}Pd .

Isotopes in physics

- 1) ^{171}Yb is currently being studied for use in an ytterbium optical lattice clock.

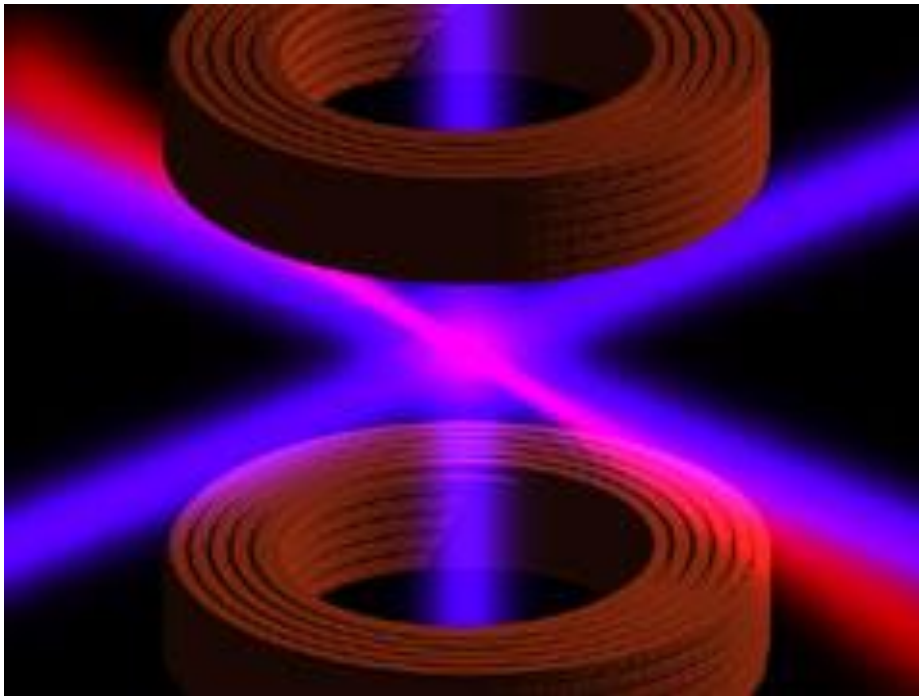


Figure 4: Inside NIST's new optical atomic clock. The red rings are magnetic coils and the red laser beam is an optical lattice. The intersecting violet lasers cool the ytterbium atoms.

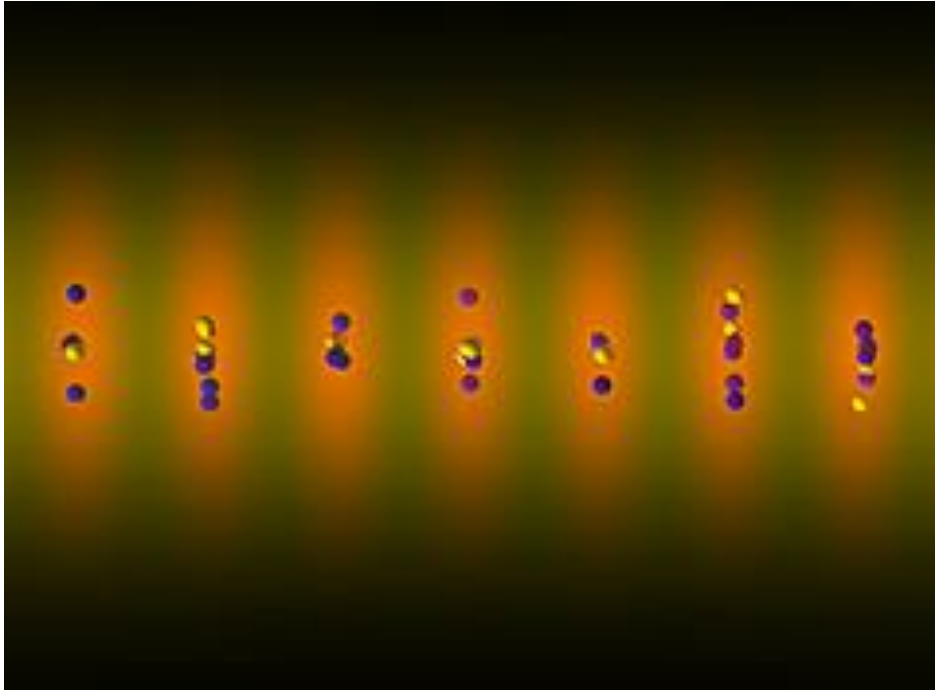


Figure 5: Ytterbium atoms are trapped in pancake shaped “wells” by a lattice of laser beams. The atoms are excited by the yellow laser causing them to oscillate between lower (blue) and higher (yellow) energy levels.